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Flare Systems Audit

Limetree Bay Refinery

Report to: Limetree Bay Refining, LLC

Date: June 25, 2021

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1 Executive Summary

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The Flare Systems Audit is part of a requirement in response to Emergency Order CAA-02-2021-1003 issued by the United States Environmental Protection Agency (EPA) on May 14, 2021.

The scope of this audit was focused on Flare Systems, particularly Flare #8 and Flare #3 as a potential backup. Specific items of focus were requested by the EPA in the Flare Systems Audit, as follows:

a) An evaluation of the condition of the tip on Flare #8;
b) Capacity of the knockout pot to handle liquids loading to prevent flare rainout;
c) Capacity of flare #3 to serve as backup to Flare #8;
d) Other damage already incurred by and to the flare system due to high liquid loading or other causes;
e) Review of procedures that can be implemented to avoid and minimize the impact of future flaring events, including:
    i. Operation of redundant amine treatment units and redundant SRU trains operated in hot standby; and
    ii. Sulfur shedding practices;
f) A review of whether and how installation of a flare gas recovery system to eliminate or minimize Flare #8 non-compliance can be expedited; and
g) An evaluation of staffing with regard to the operation and maintenance of the process unit, including staffing levels and whether operators have proper experience and training to operate the process unit safely and within required environmental limits.

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Since February 1, 2021, the EPA has identified at least four incidents which have occurred at the facility that have each had an immediate and significant health impact on multiple downwind communities.

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These incidents have been termed as:

- February 4, 2021 Incident
- Late April 2021 Incident
- First May Incident
- Second May Incident

As a result of these incidents, EPA issued Emergency Order CAA-02-2021-1003 on May 14, 2021, which required that Limetree comply with a number of action items:

- Within one (1) business day of receipt of the Emergency Order, Limetree was required to submit to EPA a written statement explaining whether they intend to and are able to comply with the Order.
- Upon receipt of the Order, Limetree was required to ensure all Refinery Operations cease until the termination of the Order (a maximum of sixty days).
- Limetree was required to notify EPA electronically as soon as possible once Refinery operations have ceased.
- Limetree was required to retain independent third-party auditors to conduct comprehensive audits, providing full access to the facility and provide or otherwise make available any necessary personnel, documents, and Facility environmental, health, and safety training to fully perform all audit activities.

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2 Introduction

2.1 Purpose of Study

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The Flare Systems Audit is part of a requirement in response to Emergency Order CAA-02-2021-1003 issued by the United States Environmental Protection Agency (EPA) on May 14, 2021.

Specific items of focus were requested by the EPA in the Flare Systems Audit, as follows:

a) An evaluation of the condition of the tip on Flare #8;
b) Capacity of the knockout pot to handle liquids loading to prevent flare rainout;
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d) Other damage already incurred by and to the flare system due to high liquid loading or other causes;
e) Review of procedures that can be implemented to avoid and minimize the impact of future flaring events, including:
    iii. Operation of redundant amine treatment units and redundant SRU trains operated in hot standby; and
    iv. Sulfur shedding practices;
f) A review of whether and how installation of a flare gas recovery system to eliminate or minimize Flare #8 non-compliance can be expedited; and
g) An evaluation of staffing with regard to the operation and maintenance of the process unit, including staffing levels and whether operators have proper experience and training to operate the process unit safely and within required environmental limits.

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2.2 Background

Based on its website, Limetree Bay Refining will be capable of processing around 200 thousand barrels per day. Key restart work at the site began in 2018, and the refinery resumed operations on February 1, 2021.

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On May 14, 2021, the United States Environmental Protection Agency (EPA) issued Emergency Order CAA-02-2021-1003 in response to several incidents which had occurred since the February 1, 2021 restart at the Limetree Bay Refining facility in St. Croix, US Virgin Islands.

Since February 1, 2021, the EPA has identified at least four incidents which have occurred at the facility that have each had an immediate and significant health impact on multiple downwind communities.

A timeline of key events since operations resumed on February 1, 2021 is provided.

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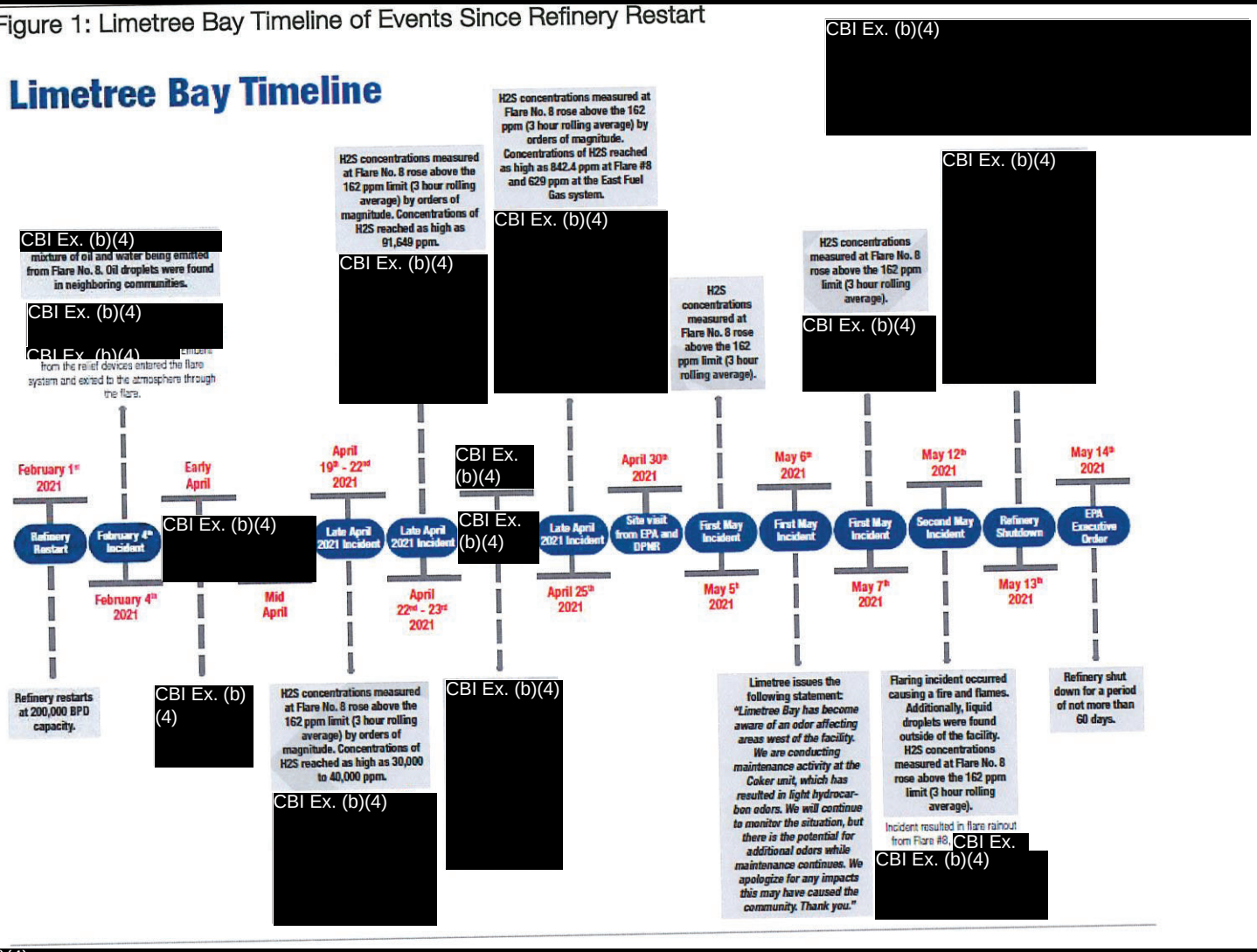
Figure 1: Limetree Bay Timeline of Events Since Refinery Restart



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2.2.1 February 4, 2021 Incident

On February 4, a mixture of oil and water, in the form of an oily mist, was emitted from Flare #8 at the refinery (the "Feb. 4 Incident"). These emissions included liquid droplets of oil.

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2.2.2 Late April 2021 Incident

Between April 19 - 23, 2021, Limetree reported to the Virgin Islands Department of Planning and Natural Resources (DPNR), exceedances of the 162 ppm emission standard for H2S concentrations measured at the flare header for Flare #8 at the facility.

Between April 19 and April 22, 2021, hydrogen sulfide concentrations measured at the Flare #8 flare header rose to orders of magnitude above the limit of 162 ppm based on a 3-hr rolling average.

High hydrogen sulfide readings on each of those four days, measured between 5 AM on April 19 and 5 PM on April 22, rose as high as 31,546.5, 39,475.7, 2,272.4, and 4,046.5 ppm, respectively (on a 3-hr rolling average basis).

Limetree continued to measure high levels of hydrogen sulfide in excess of the 162 ppm limit at the flare header for Flare #8 at the Facility during the evening of April 22 and into April 23, 2021. Hydrogen sulfide readings rose throughout the evening on April 22, and peaked at a three-hour average of 91,649.0 ppm around 11 AM on April 23.

2.2.3 First May Incident

On May 5, 2021, Limetree environmental personnel reported to DPNR and EPA that the refinery had exceeded the H2S limit at Flare #8 at approximately 9 PM EST on May 5.

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As a result of the odor, the Virgin Islands Department of Education closed three schools on May 6 and 7, 2021. Additionally, the VI Bureau of Motor Vehicles ("VIBMV") closed early on May 6, 2021 and remained closed on May 7, 2021.

On May 7, 2021, Limetree environmental personnel reported to EPA that the refinery had exceeded the H2S limit at Flare #8 at approximately 11 PM EST on May 7, 2021.

2.2.4 Second May Incident

On May 12, 2021 at approximately 5:30 PM, Limetree reported to EPA that around 3:15 PM EST a flaring incident occurred at the Refinery CBI Ex. (b)(4) causing fire or flames. CBI Ex. (b)(4) Limetree reported that during its investigation of the fire, they discovered that liquid droplets of oil were on the road west of the Facility.

Photographs and video of the Second May Incident show a large flame coming off Flare #8, with a large trailing plume of visible emissions extending a long distance. Figure 2 provides an example of images circulating on social media.

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Figure 2: Photograph of Second May Incident

Source: Image from internet (https://www.viconsortium.com)

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As a result of these incidents, EPA issued Emergency Order CAA-02-2021-1003 on May 14, 2021.

The Emergency Order required that Limetree comply with a number of action items:

- Within one (1) business day of receipt of the Emergency Order, Limetree was required to submit to EPA a written statement explaining whether they intend to and are able to comply with the Order.
- Upon receipt of the Order, Limetree was required to ensure all Refinery Operations cease until the termination of the Order (a maximum of sixty days).
- Limetree was required to notify EPA electronically as soon as possible once Refinery operations have ceased.
- Limetree was required to retain independent third-party auditors to conduct comprehensive audits, providing full access to the facility and provide or otherwise make available any necessary personnel, documents, and Facility environmental, health, and safety training to fully perform all audit activities.

The Audit Categories include:

- Category A - Environmental Compliance Audit
- Category B - Process Unit Audit(s)
    1. Flare system audit
    2. Coker audit
    3. Amine/Sulfur Recovery Unit (SRU)

These audits will be completed by the earlier of 30 days after EPA's approval of a list of auditors for a given Audit Category pursuant to subparagraph (f) of this paragraph or 42 days after issuance of this Order (25th June, 2021).

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Flare #8 Description

Based on Limetree's Flare Management Plan, the following technical details regarding Flare #8 are provided:

Table 2: Flare #8 Description

Item	Description
Flare Type	Elevated
Elevation	230 ft
Assist System	Steam
Flare Tip Type	Complex – Staged, Multi-tip
Cascaded Flare System	No
Backup Flare	No
Equipped with Flare Gas Recovery	No
Maximum Vent Gas Flow Rate	1,500,000 lb/hr
Flare Tip Manufacturer	John Zink
Date of Installation	1992

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CBI Ex. (b)(4) According to the EPA Emergency Order, CBI Ex. (b)(4) was asked to evaluate whether capacity of Flare #3 can serve as backup to Flare #8.

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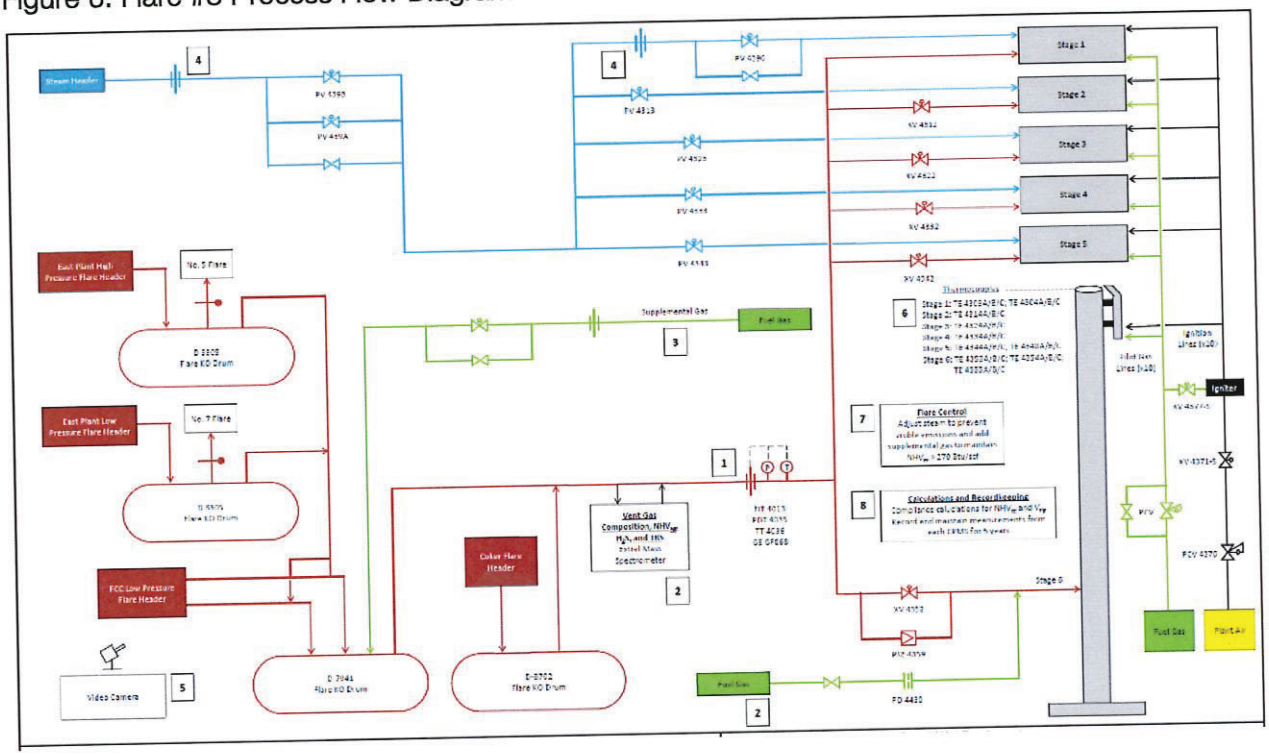
Figure 6: Flare #8 Process Flow Diagram



Source: Limetree Bay Refining, LLC, Flare Management Plan (Appendix B)

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3.3 Capacity of Flare #3 to Serve as Backup to Flare #8

The purpose of this audit item was to evaluate the capacity of Flare #3 to serve as a backup to Flare #8.

According to the Limetree Flare Management Plan, Flare #3 (STK-H-1104) is located in the west side of the facility and currently serves as the sole flare for the Utility Fractionator (TK-160) , Par-Isom, West Refinery Fuel Gas, and Truck Rack Units.

Flare #3 is a 200' tall, steam-assisted flare with an internal diameter (ID) of 36". It is equipped with 3 pilots, and the flare tip is a single 36" burner with steam assist rings in both the center and the outer ring. The LP flare header size is 30" from the currently operational units in the West Plant to the knockout drum (D-1129).

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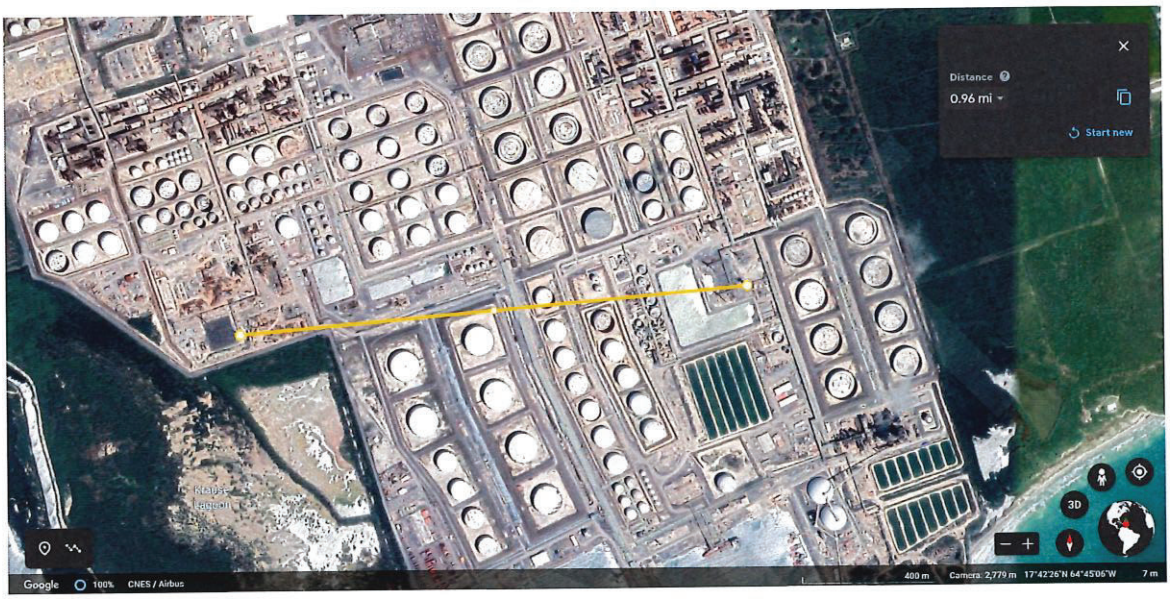
Figure 7: Aerial photograph depicting Flare #8 and Flare #3 locations and distances



Source: Google Earth

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3.4.1.3 Coke Drum D-8503 Atmospheric Release

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[redacted] on February 2nd 2021 at 07:30 the Coke Drum 3 (D-8503) experienced an atmospheric release. CBI Ex. (b)(4)

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causing the water and tarry oil mixture to flash and release to the atmosphere. CBI Ex. (b)(4)

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[redacted] the released mixture to coat one side of the adjacent Coke Drum 2 (D-8502) and neighboring structural elements (structural steel, catwalks, and scaffolding).

This resulted in hot flammable fluid being released CBI Ex. (b)(4)

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CBI Ex. (b)(4) some of the tarry D-8504 material (tar-like substance) was lifted out of the Flare #8.

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3.6 Flare Gas Recovery System Feasibility

The purpose of this section is to conduct a review of whether and how installation of a flare gas recovery system to eliminate or minimize Flare #8 non-compliance can be expedited.

Facilities with flares, which are subject to NSPS Ja and MACT CC must consider and evaluate the feasibility of installing a Flare Gas Recovery (FGR) system as part of the minimization assessment, required through 40 CFR § 60.103a (Design, Equipment, Work Practice or Operational Standards).

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Per EPA requirements, the flare minimization assessment within the Flare Management Plan must consider:

i. Elimination of process gas discharge to the flare through process operating changes or gas recovery at the source.
ii. Reduction of the volume of process gas to the flare through process operating changes.
iii. Installation of a flare gas recovery system or, for facilities that are fuel gas rich, a flare gas recovery system and a co-generation unit or combined heat and power unit.
iv. Minimization of sweep gas flow rates and, for flares with water seals, purge gas flow rates.

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The assessment must provide clear rationale in terms of costs (capital and annual operating), natural gas offset credits (if applicable), technical feasibility, secondary environmental impacts and safety considerations for the selected minimization alternative(s) or a statement, with justifications, that flow reduction could not be achieved.

Based upon the assessment, each owner or operator of an affected flare shall identify the minimization alternatives that it has implemented by the due date of the flare management plan and shall include a schedule for the prompt implementation of any selected measures that cannot reasonably be completed as of that date.

Limetree issued a revised Flare Management Plan on August 7, 2020, updated from the original plan submitted on January 30, 2020; to address these requirements, including consideration of a flare gas recovery system.

The Limetree Flare Management Plan Section 3.5 contains a high level discussion on flare gas recovery costs, natural gas offset credits, and technical feasibility; concluding that the present costs of a FGR system renders this option unfeasible. Since the conclusion was that the project was not economically feasible, consideration of secondary environmental impact, and safety considerations were not documented.

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3.8 Other Observations

The EPA Emergency Order requested that '…the contents of the audit shall not be limited to the below items if an Auditor determines that additional evaluation should be conducted".

As such, this section discusses items not explicitly listed in the Emergency Order.

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3.8.1 Process Safety Information Organization

40 CFR 68.65 outlines Process Safety Information (PSI) requirements for covered facilities. CBI Ex. (b)(4)

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3.8.4 Incident Investigation

The requirement to conduct Incident Investigations within 40 CFR 68.81 (OSHA 1910.119(m)) is one of the main elements of RMP. The EPA Emergency Order identified four main incidents, CBI Ex. (b)(4)
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Table 7 provides a comparison of the provided incident investigation reports to the requirements in 40 CFR 68.81 (OSHA 1910.119(m)).

Table 7: Limetree Incident Investigations compared to EPA RMP requirements

EPA Clause	Description	Limetree Incident Date			
		Feb 4th, 2021	Late April 2021	First May Incident	Second May Incident
40 CFR 68.81(a)	Employer shall investigate applicable incidents	CBI Ex. (b)(4) [redacted]			
40 CFR 68.81(b)	Investigation within 48 hours of incident				
40 CFR 68.81(c)	Established qualified investigation team				
40 CFR 68.81(d)	Incident Report Includes:				
40 CFR 68.81(d)	Date of Incident				
40 CFR 68.81(d)	Date Investigation Begins				
40 CFR 68.81(d)	Description of Incident				
40 CFR 68.81(d	Factors that contribute to the incident				

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EPA Clause	Description	Limetree Incident Date			
		Feb 4th, 2021	Late April 2021	First May Incident	Second May Incident
40 CFR 68.81(d)	Recommendations from investigation	CBI Ex. (b)(4)			
40 CFR 68.81(e)	Establish system to address findings and document resolutions				
40 CFR 68.81(f)	Review report with affected personnel				
40 CFR 68.81(g)	Retain report for 5 years				
Process Safety Event (PSE) Tier					

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